

CLAIMS:

1. An improved hydroprocessing process for hydrocarbon feedstreams containing nitrogen and sulfur contaminants comprising:
 - a) providing a sulfuric acid solution having a sulfuric acid concentration of at least about 75 wt.%, based on the sulfuric acid solution;
 - b) contacting a first hydrocarbon feedstream containing nitrogen and sulfur heteroatoms and having a Total Acid Number in a first contacting stage with the sulfuric acid solution under conditions effective at removing at least about 60 wt.% of the nitrogen heteroatoms contained in said hydrocarbon feedstream thereby producing at least a first stage effluent comprising at least a first hydrocarbon product stream and a first used sulfuric acid solution, wherein the volumetric treat rate of the sulfuric acid solution is greater than about 0.5 vol.%, based on the first hydrocarbon feedstream;
 - c) separating said first used sulfuric acid solution and said first hydrocarbon product stream;
 - d) cascading at least a portion of said first used sulfuric acid solution to a second contacting stage;
 - e) contacting a second hydrocarbon feedstream containing nitrogen heteroatoms and having a Total Acid Number in the second contacting stage with the first used sulfuric acid solution under conditions effective at removing at least about 60 wt.% of the nitrogen heteroatoms contained in said second hydrocarbon feedstream thereby producing at least a second stage effluent comprising at least a second hydrocarbon product stream and a

-26-

second used sulfuric acid solution, wherein the volumetric treat rate of the first used sulfuric acid solution is greater than about 0.5 vol.%, based on the second hydrocarbon feedstream, wherein the concentration of nitrogen heteroatoms in said second hydrocarbon feedstream is higher than that of said first hydrocarbon feedstream;

- f) separating said second used sulfuric acid solution and said second hydrocarbon product stream; and
- g) contacting at least a portion of said first and/or second hydrocarbon product stream with a hydroprocessing catalyst in a hydroprocessing reaction stage.

2. The process according to claim 1 wherein said first and second hydrocarbon feedstreams are selected from those hydrocarbon feedstreams boiling above about 300°F.

3. The process according to any preceding claim wherein said first and second hydrocarbon feedstreams are selected from distillate boiling range feedstreams and lube oil boiling range feedstreams.

4. The process according to any preceding claim wherein said distillate boiling range feedstreams are selected from distillate boiling range feedstreams that are not hydrotreated, are a blend of non-hydrotreated distillate boiling range feedstreams, previously hydrotreated distillate boiling range feedstreams, blends of hydrotreated distillate boiling range feedstreams, blends of non-hydrotreated and hydrotreated distillate boiling range feedstreams, and said lube oil boiling range feedstreams are selected from

-27-

reduced crudes, hydrocrackates, extracts, hydrotreated oils, atmospheric gas oils, vacuum gas oils, coker gas oils, atmospheric and vacuum resids, deasphalted oils, slack waxes, raffinates, and Fischer-Tropsch wax, and mixtures thereof.

5. The process according to any preceding claim wherein the first and second hydrocarbon feedstreams contain about 25-2500 wppm nitrogen.
6. The process according to any preceding claim wherein the 25-2500 wppm nitrogen includes carbazole and/or substituted carbazoles.
7. The process according to any preceding claim wherein said sulfuric acid solution contains greater than about 80 wt.% sulfuric acid.
8. The process according to any preceding claim wherein said sulfuric acid solution is obtained from an alkylation process unit.
9. The process according to any preceding claim wherein said alkylation process comprises:
 - a) combining an olefinic hydrocarbon feedstream containing C₄ olefins with isobutane to form a hydrocarbonaceous mixture; and
 - b) contacting the hydrocarbonaceous mixture with sulfuric acid under conditions effective for producing at least an alkylate and a sulfuric acid solution having an acid concentration of at least about 75 wt.%.

-28-

10. The process according to any preceding claim wherein a diluent is added to said sulfuric acid solution to adjust the sulfuric acid concentration of said sulfuric acid solution.

11. The process according to any preceding claim wherein the sulfur concentration of the first and second hydrocarbon product streams is about 0.1 to about 25 wt.% less than the respective first and second hydrocarbon feedstreams.

12. The process according to any preceding claim wherein the yield loss attributed to the sulfuric acid solution treatment in the first and second contacting stages is about 0.5 to about 6 wt.%.

13. The process according to any preceding claim wherein the treat rate of the sulfuric acid solution and the first used sulfuric acid solution is about 0.5 to about 20 vol.%

14. The process according to any preceding claim wherein the first hydrocarbon feedstream and the sulfuric acid solution and the second hydrocarbon feedstream and the first used sulfuric acid solution are intimately contacted by a contacting method selected from non-dispersive and dispersive contacting methods.

15. The process according to any preceding claim wherein first hydrocarbon product stream and the first used sulfuric acid solution and second hydrocarbon product stream and the second used sulfuric acid solution are separated by any means known to be effective at separating an acid from a hydrocarbon stream.

-29-

16. The process according to any preceding claim wherein the first hydrocarbon product and the first used sulfuric acid solution and the second hydrocarbon product stream and the second used sulfuric acid solution are separated by a separation device selected from settling tanks or drums, coalescers, electrostatic precipitators, and other similar devices.

17. The process according to any preceding claim wherein said hydroprocessing process is selected from hydrotreating, hydrocracking, ring opening, aromatics saturation, hydrodewaxing, and hydrofinishing.

18. The process according to any preceding claim wherein said process further comprises contacting at least a portion of said second hydrocarbon product stream with a hydroprocessing catalyst in a hydroprocessing reaction stage.

19. The process according to any preceding claim wherein said process further comprises separately contacting said first and second hydrocarbon product streams with an effective amount of an acid reducing material selected from caustic and water under conditions effective at reducing the total acid number of said first and second hydrocarbon product streams product prior to hydroprocessing.

20. The process according to any preceding claim wherein at least one of the first and second hydrocarbon feedstreams is selected from non-hydrotreated distillate or a blend of non-hydrotreated distillates.

-30-

21. The process according to any preceding claim wherein the sulfuric acid solution has an acid concentration of greater than about 76 wt.%, a water concentration of about 2 wt.% to about 12 wt.%, and a dissolved oil concentration of less than about 12 wt.%.
22. The process according to any preceding claim wherein at least one of the first and second hydrocarbon feedstreams is selected from hydrotreated distillate, or a blend of hydrotreated distillates, each of which may or may not contain cracked stock.
23. The process according to any preceding claim wherein the sulfuric acid solution used to treat the hydrotreated distillate, or a blend of hydrotreated distillates, each of which may or may not contain cracked stock, has an acid concentration of greater than about 79 wt.%, a water concentration of about 2 wt.% to about 9 wt.%, and a dissolved oil concentration of less than about 12 wt.%.
24. The process according to any preceding claim wherein at least one of the first and second hydrocarbon feedstreams is selected from non-hydrotreated distillate or a blend of hydrotreated distillates, containing greater than 10% cracked stock, based on the distillate or blend.
25. The process according to any preceding claim wherein the sulfuric acid solution used to treat the non-hydrotreated distillate or a blend of hydrotreated distillates, containing greater than 10% cracked stock, based on the distillate or blend, has an acid concentration of greater than about 79 wt.%, a water

-31-

concentration of about 2 wt.% to about 9 wt.%, and a dissolved oil concentration of less than about 12 wt.%.

26. The method according to any preceding claim wherein at least one of the first and second hydrocarbon feedstreams is selected from distillate boiling range feedstreams containing greater than 40 wt.% cracked stock.

27. The process according to any preceding claim wherein the sulfuric acid solution used to treat the distillate boiling range feedstreams containing greater than 40 wt.% cracked stock is used at a treat rate of about 3 vol.% to about 6 vol.% based on the distillate boiling range feedstream.

28. The method according to any preceding claim wherein at least one of the first and second hydrocarbon feedstreams is selected from lube oil boiling range feedstreams.

29. The method according to any preceding claim wherein the sulfuric acid solution used to treat the lube oil boiling range feedstreams contains about 85 wt.% to about 93 wt.% sulfuric acid, and about 0.5 to about 5 wt.% water, with the remaining balance being acid suspended hydrocarbons.

30. The method according to any preceding claim wherein at least one of the first and second hydrocarbon feedstreams is selected from raffinates.

31. The method according to any preceding claim wherein the sulfuric acid solution used to treat the raffinates contains about 92 to about 88 wt.% sulfuric

-32-

acid, about 1.5 to about 4 wt.% water, with the remaining balance being suspended hydrocarbons.